lit. hist. V. 6

A LETTER TO BENJAMIN FRANKLIN, LL.D.

k

FELLOW of the ROYAL SOCIETY.

In which his Pretenſions to the Title of NATURAL PHILOSOPHER are conſidered.

> Omnis enim Philoſophiæ difficultas in eo verſari videtur, ut a phænomenis motuum inveſtigemus vires naturæ, deinde ab his viribus *demonſtremus* phænomena reliqua.
>
> NEUT. PR. AD PRIN.

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M.DCC.LXXVII.

G.R. III

A LETTER, &c.

SIR,

WHEN the public have once conceived a great opinion of any man's abilities, they give him credit for whatever he chuſes to advance; and whoever ſhould endeavour to perſuade them that they have been miſtaken, will meet with an indifferent reception, and may probably be conſidered as offering them an inſult.

This makes it neceſſary that the republic of letters ſhould never be without ſome bold critic, in every branch of learning, to bring a man's pretenſions to a ſtrict examination, before his reputation get to ſuch an height as to be of pernicious example.

But an author, whoſe reputation has been acquired by ſome diſcovery in ſcience, and who has beſides the merit of being illiterate, is in ſome reſpects out of the reach of criticiſm; becauſe, in this caſe, things not very conſiſtent with each other are ſure to be advanced and defended. For, if he be convicted of blundering in points of learning, or ſhould be proved ignorant of every thing done by others, in the very ſcience to which he chooſes to refer his own diſcoveries, his deficiencies, inſtead of turning to his diſcredit, will be conſidered as ſo many vouchers for his great abilities. Nor will his admirers reſt ſatisfied with this, but the man himſelf muſt be reputed a prodigy, and all uſeful knowledge limited to his acquirements: and, in order to favour this opinion, the philoſopher himſelf (for he can be no leſs) never fails to inform us, if not in direct terms, at leaſt by broad hints, that he arrived at his preſent eminence, though ignorant of many branches of learning which have been generally reputed uſeful.

Such prodigies have never been favourites of mine; nor can I recollect any inſtance, where their writings have not convinced me, in the ſtrongeſt manner, of the neceſſity of a regular education, for every one from whom any uſeful improvement in ſcience is to be expected.

As you are one of thoſe ſelf-taught philoſophers, I am ſufficiently ſenſible of the diſadvantages which I labour under, in attempting to call in queſtion your pretenſions to the title of Natural Philoſopher: tho' I might take ſome boldneſs from this conſideration, that the matter in debate may be conſidered as capable of demonſtration; and yet I ſhall be very much diſappointed if this endeavour to ſet them right meet with a tolerable reception from the public.

It may probably be aſked, Why this Letter makes its appearance now, after the world have been ſo long in poſſeſſion of your writings? The truth is, my acquaintance with them commenced but very lately; for, in the firſt place, I am not very fond of novelties; and, ſecondly, you may very eaſily believe that a man who has ſpent the greateſt part of his time in the ſtudy of Newton's Principles, and the ſciences neceſſary for underſtanding that book, might hear of people rubbing glaſs tubes without any violent curioſity about the conſequences. But more eſpecially if he had perſuaded himſelf that Newton reaped ſo compleat an harveſt, as to leave but poor gleanings for poſterity.

But ever ſince the American diſputes engaged ſo much of the public attention, we have had our ears ſtunned, even in the country, with the ſurpriſing diſcoveries of ſo great a Philoſopher as you have been repreſented; and your vaſt abilities have been ſo much the topic of general converſation, that a man was hardly fit for ſociety who had not ſome opinion concerning them. Tho' before this I truſted to report, both for your fame and your diſcoveries; yet now I could not think that I did juſtice either to you or myſelf, if I delayed any longer to give your writings an attentive peruſal; and this (to ſpeak in the language of news-writers) afforded me matter for various ſpeculations, and ſome of them by no means agreeable: for, I am ſorry to ſay it, I found in them what ſufficiently convinced me that you are ignorant both of Philoſophical Reaſoning and Philoſophical Principles, I mean thoſe which have been moſt ſucceſsfully applied to explain the appearances of nature; which grieves me the more, becauſe, from the great reputation you and others of your ſtamp have acquired, it is to be apprehended we are in danger of loſing every idea of true philoſophy——You no doubt perceive already that the ſtyle of this Letter will be very different from the compliments you have been accuſtomed to, eſpecially when they ran ſo high that your modeſty obliged you to conceal them, and only leave aſteriſks for the indulgent reader to fill up according to his imagination. Yet nevertheleſs I declare that I am above being actuated by party prejudice, having undertaken theſe ſtrictures upon your writings, for no other reaſon but becauſe I think they contain more ridiculous abſurdities, under the notion of Philoſophical Reaſonings, than any book I know, at leaſt that is ſo generally read; and that from the ſwarms of Philoſophers we meet with every where, of the ſame reach and qualifications, your works may be uſed with great propriety as a barometer for diſcovering the ſtate of Philoſophy at this preſent time.

I am very ſenſible that this is an ungrateful employment, as it ſubjects a man to ſeveral imputations; for the world will not readily believe that a zeal for things in which every body has an equal concern, is not tinctured with malice, or envy, or ſome other vicious paſſion. This has determined me to touch as ſlightly as poſſible upon your miſtakes, and rather confine myſelf to ſuch hints as may enable a reader to diſcover them himſelf, unleſs I ſhall be obliged to produce them in my own vindication. I am the rather inclinable to purſue this method, being perſuaded, that if people could be prevailed upon to examine one or two philoſophical queſtions, ſo minutely as to be able to form a clear notion of Newton's method of reaſoning, and then compare it with yours; this would be a very probable means of removing ſome of thoſe numberleſs corruptions which are daily creeping into Natural Philoſophy: and that to ſuch a degree as to be in danger of verifying a remark, which I uſed to think proceeded from the ignorance of thoſe who made it; namely, that the Newtonian Philoſophy is one of thoſe faſhionable ſyſtems which depend upon the humour of the people, and as that changes, give place to ſome new ſcheme.

In many ſubjects there is ſome excuſe when we ſuffer ourſelves to be impoſed upon, as the merits of the cauſe may be doubtful, from the great uncertainty to which moſt ſciences are liable. But if we bear with an impoſition in Natural Philoſophy, it muſt proceed from our own lazineſs, ſince Newton has left us ſuch admirable ſtandards of perfection, by which we can diſtinguiſh the genuine offspring of nature and philoſophical inveſtigation from every corruption that apes it.

Every one who obſerves facts, and records them faithfully, has a right to our thanks and eſteem: but to conſider ſuch as Natural Philoſophers, can have no other conſequence than to bring the ſcience into contempt. They may be fit to be employed as hewers of wood and drawers of water for the ſervice of the temple, tho' by no means proper to be admitted to miniſter at the altar.

God hath made every thing in the material world by weight and meaſure; and whoever pretends to comprehend any part of his works, muſt be well ſkilled in the ſcience of magnitude and number. Cauſes aſſigned muſt be adequate to the effects produced by them: but if a man cannot compute the effects, all his reaſonings from them are but mere conjectures, and his fineſt conjectures only ſports of the imagination. Not but that there are certain obvious agreements and differences among things, of which our ſenſes can judge immediately; and to aſcertain which, it would be as ridiculous to apply reaſoning or computation, as for a taylor to take meaſure for a ſuit of cloaths by a quadrant.

Thoſe people whoſe employment it is to claſs things according to their obvious ſhapes, ſizes, or colours, uſed until very lately to be content with the humble appellation of Natural Hiſtorians; and their province was ſuppoſed to be confined to mere matter of arrangement, contenting themſelves with a ſuperficial view of things, without prying into the ſecrets of nature any farther than ſhe diſcovers them to the ſenſes of all mankind. But of late years it has become a practice, frequent with theſe Hiſtorians, to preſent us with a ſyſtem of the univerſe, and then take their ſeat among the Philoſophers. This has been Buffon's method, who, if he had confined himſelf to his proper buſineſs, muſt have been contented with the title of Natural Hiſtorian; but no ſooner has he formed our Earth and the Planets, out of Splinters, which he makes a Comet break off from the Sun, than he is immediately to be ſtyled a Philoſopher.

A miſtaken notion generally entertained concerning Experimental Philoſophy, ſeems to have been the occaſion of ſuch authors ſtepping out of their road to turn Philoſophers; for it is commonly ſuppoſed, that to make a few experiments and obſervations, and then reaſon about them in any manner, is ſufficient to entitle one to the appellation of Natural Philoſopher. But in this ſenſe there never have been any attempts at Philoſophy which were not experimental; at leaſt, I know of none, where the authors do not reaſon from experiments in their manner.

But

But unleſs their experiments lead to ſome general principle, the effects of which can be accurately computed, they cannot with any propriety be called even philoſophical facts; but if the Experimentaliſts want either learning or abilities to trace them up to ſome general principle, when they lead to ſuch, they would diſcover their knowledge and philoſophic diſcernment much more by letting them reſt as facts, than by introducing a jargon which is nothing to the purpoſe, as you have done, to give your diſcoveries an air of philoſophical inveſtigation.

There is a ſort of people, who have got a rage for making experiments, without the knowledge or learning neceſſary for making the proper uſe of them; who, when they have been ſucceſsful in a few inſtances, immediately ſet about explaining all appearances from their experiments. Whereas, if they had learning, the failures of others would have taught them modeſty; and a knowledge of the proper method of inveſtigation, would have diſcovered the abſurdity of their own proceedings.

I have read of one of theſe gentlemen, who by attentive obſervation, and ſome microſcopical experiments, had been able to ſhew that there were Worms in more places than was generally obſerved. But the reputation of this would not ſatisfy him; every thing muſt be accounted for from his Theory of Worms: in ſhort, his mind was ſo much elated, and his imagination ſo poſſeſſed with his late diſcoveries, that every thing muſt be converted into Worms.

In the ſame manner your Electrical Matter is to account for all appearances of nature. And even our moſt familiar language, if we would expreſs ourſelves with propriety, ought to be ſeaſoned with terms of art borrowed from Electricity. Thus a man cannot warm his hands without a Conductor to convey the heat to them; nor burn his fingers when he lays hold of a boiling tea-kettle, but for want of a wooden handle, or ſome ſuch Non-conductor.

Your *Seas of Globes and Cuſhions* (as you expreſs yourſelf) are to be found every where, like the abovementioned gentleman's Worms, rubbing againſt each other, electrifying all nature, and producing every phænomenon.

O the vanity of human conceits! O Philoſophy, to what a phantom art thou reduced! O Newton, if any ſublunary thing be worth thy notice, how muſt thou lament to ſee this nation gazing, with admiration, at Electricians feaſting on turkeys killed by electrical ſhocks, and ſtyling themſelves Natural Philoſophers, and their feaſts philoſophical banquets!

In diſcoveries of great importance, it generally happens, that the firſt ſteps have but very little in them that is inviting to an ordinary capacity; and therefore it is only to thoſe, who have ſuch comprehenſive minds as are able to foreſee the remote conſequences of them, that they can be in any meaſure engaging; ſo that whoever employs himſelf in ſuch ſpeculations, has a chance to come well prepared for his buſineſs, and with ſuch knowledge as the particular circumſtances of it may require. But it has fallen out unluckily for Electricity, that the experiments, affording amuſement even for children, have engaged the attention of ignorant men, who ſeem to have taken up this ſtudy with no other qualification but a ſtrong diſpoſition to ſtare.

If you had prepared yourſelf, by a proper courſe of mathematical ſtudy, for underſtanding Newton's reaſoning, an attentive obſervation of the views he evidently had in making his experiments, muſt ſoon convince you, that your experiments were by no means calculated to eſtabliſh Electricity as a philoſophical principle. Any one may be convinced of this, who attends to Gravity, conſidered as a philoſophical principle, and takes but a curſory view of the uſe to which Newton has applied it.

The manner in which a ſtone falls to the earth, the motion of the planets round the ſun, the ebbing and flowing of the ſea, are appearances among which an ordinary capacity could perceive but little reſemblance; and yet this great Philoſopher has proved, in the moſt ſatisfactory manner, that they all proceed from the ſame principle, which acts uniformly wherever there is matter, and by its manner of acting diſcovers the kind and quantity even of ſuch matter as ſeems naturally placed far beyond our ſphere. Hence it comes to paſs, that the denſity of the Sun and Planets, with reſpect to each other, and to our Earth, is rendered as much a ſubject of computation, as the ſpecific gravity of lead and feathers.

But it would have been in vain to look for conſiſtency among theſe appearances, or to attempt to get at ſuch concluſions, if the force of gravity had not been ſhewn to be a fixed determinate thing; and as much a ſubject of computation, as the time you would take to travel twenty miles, ſuppoſing the ſpace you travelled over in an hour to be known.

I ſhould be glad to be informed of any principle in Electricity, of which the effects may be thus computed; for otherwiſe, we can never be certain that the effects are produced by it, unleſs it can be ſhewn that its force is adequate to the production of them ——You may probably tell me, that there are a great many curious facts in Electricity, fully eſtabliſhed by experiments: and I in return can anſwer you, that there were a great many curious properties of Gravity known and fully eſtabliſhed, long before it ever entered into the head of any man to conſider it as a philoſophical principle: And for the encouragement of thoſe who may chooſe to take Electricity out of ſuch ignorant hands, even that remarkable property of it, which coſt Newton ſo many ingenious experiments to confirm, namely, that every particle of matter gravitates, muſt have been generally known and believed, before weighing could with any propriety be uſed as a meaſure for the quantity of matter.

Beſides, Gravity, even in its vulgar ſtate, furniſhes a great variety of entertaining experiments: the rolling of a ſtone down a declivity might be ſo managed as to deſerve the approbation of the admirers of Electricity. But depend upon it, without conſiderable mathematical knowledge, there is no poſſibility of eſtabliſhing principles in Natural Philoſophy; you may amuſe the vulgar with your experiments, but this will never enlarge the boundaries of ſcience, nor ſecure your own reputation.

Newton has ſaid, that as in Mathematics, ſo in Natural Philoſophy, the inveſtigation of difficult things ought firſt to be attempted in the way of analyſis. That is to ſay, certain things may be taken for granted as principles;

ciples; but one ſhould think it would be hardly neceſſary to caution a Philoſopher, that his principles be ſuch as conſequences can be fairly inferred from. We are then to obſerve, whether any natural appearances are the ſame with theſe conſequences; becauſe, if they are, we may conclude that the principles from which we reaſoned are really in nature: and this is the uſe of hypotheſes in philoſophy. But I ſhall be a little more particular in explaining the uſe of hypotheſes, and eſpecially becauſe Newton's authority is often alledged for the miſapplication of them.

I grant it is very allowable to reaſon hypothetically, and to imagine cauſes, the exiſtence of which may be doubtful; but in doing this it is neceſſary to obſerve (as I mentioned before) that the cauſes muſt be ſuch that the effects can be accurately computed, otherwiſe we do nothing but dream. As, for example, I may ſuppoſe the Earth to be of a ſpherical figure, and to turn upon its axis; and then from theſe principles demonſtrate a great many conſequences, ſuch as the time of Sun-riſing and Sun-ſetting every where upon its ſurface, the apparent motions and ſituations of the Fixed Stars; and by the aſſiſtance of ſuch concluſions, determine the relative ſituations of places, or in vulgar language, *find out the Longitude*: All theſe concluſions, and an infinite variety of others, could be fairly demonſtrated to follow, from the motion and ſpherical figure of ſuch a body as we have ſuppoſed, even allowing that no ſuch body ever exiſted. But if natural appearances agreed every where with the computations, we might conclude, in the moſt ſatisfactory manner, that the figure and motion reaſoned from are ſuch as really have an exiſtence in nature. But without mathematical knowledge, ſuch concluſions could never be obtained.

In the ſame manner, the three laws of Motion may be conſidered as ſuppoſitions, and the actions of bodies upon each other computed according to ſuch principles; and the different compoſitions and reſolutions of Motion explained and demonſtrated. But if we find natural bodies in ſuch ſituations, or can put them into ſuch as agree with our computations, we conclude, in the ſame manner, that theſe are laws of nature.

In ſhort, the general rule is this; ſuch principles are proper to be taken for granted, and our experiments ſhould be directed to eſtabliſh thoſe from which conſequences may be fairly deduced (I mean computed); but to reaſon from any principles which are too indeterminate, or not ſo fully eſtabliſhed as to have conſequences properly inferred from them, is a childiſh miſapplication of time; whether the principles be in nature, or are taken for granted. But even hypothetical principles, the effects of which can be computed, are to be attended to, as appearances may afterwards agree with the computed effects, and thus the real principles which operate in nature may be diſcovered.

I have been tediouſly particular in explaining this point; but there ſeems to be ſuch a general miſconception of it, that it appeared neceſſary. But thoſe who are deſirous of forming accurate notions upon this ſubject, muſt have recourſe to Newton's *Mathematical Principles of Natural Philoſophy*, where they will find a wonderful and elegant variety of philoſophical principles and their conſequences. This is a book, (tho' I am ſorry to ſay it) which ſeems to be but little regarded or underſtood by the preſent race of Philoſophers. It is indeed with the greateſt regret, that I ſee an inſtrument ſo univerſal and accurate, and beſides ſo portable, as the ſcience of Mathematics, in danger of falling into diſuſe; and clumſy inaccurate inſtruments, which can be only partially applied, ſubſtituted in its ſtead.

The modern method of *handling* Natural Philoſophy, is apt to put one in mind of the virtuoſos in Gulliver's Travels, who, neglecting the uſe of language, were to converſe together by producing the things themſelves which were the ſubject of their diſcourſe; only with this difference, that if a modern Philoſopher were to explain, in his way, what Newton has univerſally and fully demonſtrated in a ſingle corrolary, concerning the Mechanical Powers, (whether oblique or direct) inſtead of a pedlar's pack, he muſt be attended by a waggon loaded with things.

Nor is this the worſt conſequence of ſuch a method; for men wholly illiterate are, by the aſſiſtance of theſe inſtruments, qualified for commencing Philoſophers; ſeeing one who can neither underſtand a demonſtration or computation, may neverthelefs be qualified for blowing up bladders in an air pump, or for drawing ſparks from an electrical-machine. Thus the ſcience has been filled with mechanical and vulgar expreſſions, even to ſuch a degree, as to diſcover the company it has kept, by the language it ſpeaks. You yourſelf furniſh us with many inſtances of your low-breeding in this reſpect; and, amidſt all your philoſophical parade, it is eaſy to diſcover the *Worker at the Preſs:* for inſtance, what do you mean by a *four-ſquare* hole?

I would not, however, have any one imagine, that I am entirely againſt illuſtrating propoſitions in Natural Philoſophy, by particular experiments. The weakneſs of the human mind often requires ſuch aſſiſtance: but never to get beyond them, nor to be able to lay them aſide, muſt proceed entirely from neglecting to make a proper uſe of our faculties. Such experiments, with reſpect to the aſſiſtance they lend the mind, may be compared to the ſcaffolding of a building, which, tho' it may give one a clear notion of the manner in which it was raiſed, yet if it were to attend it conſtantly, would be a monſtrous incumbrance, and prevent the diſcovery either of its beauty or proportion.

It is ſo diſagreeable to me to find fault, that I have endeavoured to keep your writings as much out of my ſight as was in any meaſure conſiſtent with my plan: this is the reaſon why I have dealt ſo much in generals, without references to particular paſſages of your book: but it will no doubt be expected, before I conclude, that I ſhould give ſome ſpecimen of your method of reaſoning, expreſſed in your own words. Some people would pitch upon the moſt abſurd parts of your writings for this purpoſe; thoſe, where you *are very much in the dark about light*, and under terrible apprehenſions leſt the Sun ſhould be burnt out, unleſs the Newtonian Theory of Light be overturned: or where you chooſe to contradict Solomon, by aſſerting, that the rivers, inſtead of running into the ſea, run up into the air: but I ſhall take the following, where you ſeem to have beſtowed a great deal of pains to reduce it to method, and have beſides given us a ſpecimen

men of your manner of applying Mathematics:

Page 56. Sec. 11. you ſay, "If a piece of "common matter be entirely free from elec"trical matter, and a ſingle particle of the "latter be brought nigh, it will be attracted "and enter the body, and take place in the "center, or where the attraction is every "way equal. If more particles enter, they "take their places where the balance is equal "between the attraction of the common "matter and their own mutual repulſion. "'Tis ſuppoſed they form *triangles*, whoſe "ſides ſhorten as their number increaſes, "till the common matter has drawn in ſo "many, that its whole power of compreſſing "thoſe *triangles*, by attraction, is equal to "their whole power of expanding them"ſelves, by repulſion, and then will ſuch "piece of matter receive no more."

Sec. 12. "When part of this *natural pro*"*portion* of electrical fluid is taken out of a "piece of common matter, the *triangles* "formed by the remainder are ſuppoſed to "widen by the mutual repulſion of the parts, "until they occupy the whole piece."

Sec. 13. "When the quantity of electri-
"cal fluid taken from a piece of common
"matter is reſtored again, it enters, the ex-
"panded *triangles* being again compreſſed, till
"there is room for the whole."

Sec. 14. "To explain this, take two
"apples, or two balls of wood, or other
"matter, each having its own natural quan-
"tity of the electrical fluid. Suſpend them
"by ſilk lines from the cieling. Apply the
"wire of a well charged vial, held in your
"hand, to one of them, A, (fig. 7.) and it
"will receive from the wire a quantity of the
"electrical fluid; but will not imbibe it, being
"already full. The fluid therefore will flow
"round its ſurface, and form an electrical
"atmoſphere. Bring A into contact with
"B, and half of the electrical fluid is com-
"municated, ſo that each has now an elec-
"trical atmoſphere, and therefore they repel
"each other: Take away theſe atmoſpheres,
"by touching the balls, and leave them in
"their natural ſtate: then, having fixed a
"ſtick of ſealing wax to the middle of the
"vial, to hold it by, apply the wire to A, at
"the ſame time the coating touches B.

“ Thus will a quantity of the electrical fluid
“ be drawn out of B, and thrown on A. So
“ that A will have a redundance of this fluid
“ which forms an atmoſphere round it, and
“ B an exactly equal deficiency. Now bring
“ theſe balls again into contact, and the electrical atmoſphere will not be divided between A and B, into two ſmaller atmoſpheres, as before; for B will drink up
“ the whole atmoſphere of A, and both will
“ be found again in their natural ſtate.”

I ſhall make no remarks upon this mode of illuſtration, nor pretend to ſay what it is that has been illuſtrated; but ſhall juſt take a little notice of your method of introducing Mathematics. You certainly are not ſo ignorant as to imagine that it was in this manner Newton applied Mathematics to explain Natural Philoſophy? Do you think that he introduced mathematical figures merely to give an air of learning to his writings? He introduces no figures from which he does not deduce conſequences; and what is more, the very figure he introduces is the only one which could have anſwered his purpoſe; whereas, for any uſe you make of your *triangles,*

triangles, any other figure would have done your buſineſs equally well.

I am not conſcious to myſelf of having in the leaſt article miſrepreſented your works, in the character I have given of them. But, if either you or your friends can point out any principle, from which you have deduced conſequences in a philoſophical manner, I ſhall be very ready to retract my cenſure.

I am, Sir, &c.

FINIS.